RANDOM ACCESS CONTROL METHOD AND SYSTEM

FIELD OF THE INVENTION

5   The present invention relates to a method and system for performing random access in a mobile communication network comprising a base transceiver station and a mobile station, such as a radio access network of a WCDMA (Wideband Code Division Multiple Access) system like the UMTS (Universal
10 Mobile Telecommunications System).

BACKGROUND OF THE INVENTION

WCDMA has been chosen as the radio technology for the
15 paired bands of the UMTS. Consequently, WCDMA is a common radio technology standard for third-generation wide-area mobile communications.

A fast and efficient random access procedure has been
20 defined in the WCDMA system, wherein random access is based on a slotted Aloha transmission of a random access burst. The burst contains a preamble part, where a cell specific preamble code is used to transmit a preamble sequence randomly picked by the mobile station. The preamble
25 sequence is detected in the receiver using a matched filter, and specifies a subset of a code tree that defines the channelization code (short code) used for an RACH (Random Access CHannel) message part.

30 In particular, a random access communication between a mobile station and the base transceiver station is established by means of an uplink PRACH (Physical Random Access Channel) and a downlink AICH (Acquisition Indication Channel), wherein the PRACH carries a RACH (Random Access

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Channel) through which the mobile station communicates with
the base transceiver station. The mobile station transmits
a random access message to the base transceiver station via
the RACH when it wants to initiate a dedicated channel for
5   e.g. a speech connection or it has some packet data which
are to be transmitted. The base transceiver station
transmits acknowledgments of RACH preamble signatures to
the mobile station on the AICH, according to which the RACH
message transmission is started.

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However, in the common proposals for the WCDMA system, only
a subset of all possible PRACH and AICH access slots is
used, which limits the capacity of the RACH. This is not
desirable especially in cases of high network loads.

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Moreover, the number of access slots of the PRACH and the
AICH is low. A preamble and an acquisition indicator (AI)
may be transmitted every third or fourth access slot, so
that the amount of hardware resources to be allocated to
20   the RACH reception is low. If a single PRACH with such a
limited capacity is not sufficient for a random access
procedure, several PRACH and AICH channels per cell of the
base transceiver station have to be configured. This leads
to an undesirable complex random access procedure.

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SUMMARY OF THE INVENTION

It is therefore an object of the present invention to
provide a random access method and system, which enable a
30   more flexible use of the random access channels.

This object is achieved by a method for performing random
access in a mobile communication network having a base

transceiver station and a plurality of mobile stations, comprising the steps of:

transmitting a parameter defining allowed uplink access slots from the base transceiver station to a mobile

5   station;

determining said allowed uplink access slots at the mobile station based on the parameter; and

using at least one of the determined allowed uplink access slots for performing a random access operation to the base

10   transceiver station.

Furthermore, the above object is achieved by a system for performing random access in a mobile communication network, comprising:

15   a network element arranged for transmitting a parameter defining allowed uplink access slots; and

a plurality of mobile stations arranged for receiving the transmitted parameter, for determining the allowed uplink access slots based on the received parameter, and for using

20   at least one of the determined allowed uplink access slots for performing a random access to the base transceiver station.

Additionally, the above object is achieved by a network

25   element for a mobile communication network comprising a plurality of mobile stations, comprising:

setting means for setting a parameter defining allowed uplink access slots for performing a random access operation; and

30   transmitting means for transmitting the parameter to the plurality of mobile stations.

In addition thereto, the above object is achieved by a mobile station for a mobile communication network having at

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least one network element allowing a random access
operation, comprising:
receiving means for receiving from the network element a
parameter defining allowed uplink access slots for the
5   random access operation;
determining means for determining the allowed uplink access
slots based on the received parameter; and
transmitting means for transmitting a random access message
to the network element using at least one of the determined
10   allowed uplink access slots.

Accordingly, the allowed access slots of the random access
channels can be defined and signaled to the mobile
stations. The same algorithms can be used by the mobile
15   station and the base transceiver station to determine the
access slots in which the transmission or reception can be
performed, based on required parameters. Thus, the number
of allowed access slots can be defined by the network and
may be changed even dynamically based on the random access
20   messaging load or hardware parameters.

According to the invention, the number of allowed access
slots of the random access channels can be configured to
match more closely the requirements of the random access
25   communication. Since the network defines the allowed access
slots, hardware resources of the base transceiver station
can be taken into account when deciding on the number of
allowed access slots. The selection of the uplink access
slots for each preamble transmission can be randomized, to
30   thereby reduce preamble collisions. Since the number of
allowed access slots for the random access channels is a
network-specific variable, the amount of base transceiver
station resources which must be allocated to random access
reception and transmission may change dynamically.

Preferably, the parameter is transmitted via a broadcast channel, such as the BCH channel of the WCDMA system. The random access may be performed via the PRACH uplink channel
5 and the AICH downlink channel.

The parameter may define a subset of available access slots of the mobile communication network. The subset may be determined by another parameter transmitted from the base
10 transceiver station to the mobile station, wherein the other parameter can be a timing parameter defining a transmission timing of an uplink access slot. The other parameter may also be transmitted via the broadcast channel. Preferably, the bit number of the parameter may be
15 changed in dependence on the other parameter.

A transmission of a preamble signature or an acquisition indication may be disabled in dependence of the value of the parameter.
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Furthermore, an index of an allowed uplink access slot may be calculated on the basis of the value of the parameter and a frame number of a frame used for transmitting an uplink access slot. In this case, the parameter may
25 determine an offset to be added to the calculated index.

The allowed downlink slots may be determined by adding a predetermined value to an index of a received uplink slot. In this case, the predetermined value may depend on a
30 timing parameter defining a transmission timing of the uplink slot.

Alternatively, an index of an allowed uplink access slot may be determined on the basis of the value of the

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parameter irrespective of a frame number of a frame used
for transmitting an uplink access slot.

Additionally, the binary configuration of the parameter may
5   determine a combination of calculated indices obtained for
other values of the parameter, wherein the other values
corresponds to the binary weights of the binary
configuration. -

10   The base transceiver station may comprise a transmitting
means arranged for transmitting the parameter via the
broadcast channel.

Furthermore, the setting means may be arranged to set the
15   parameter in dependence on the timing parameter value
defining a transmission timing of an uplink access slot in
the random access operation.

Additionally, the determining means of the mobile station
20   may be arranged to determine the allowed uplink access
slots on the basis of the received parameter and the timing
parameter. In particular, determining means may be arranged
to calculate an index of an allowed uplink access slot on
the basis of the value of the received parameter and a
25   frame number of a frame used for transmitting an uplink
access slot. Alternatively, the determining means may be
arranged to determine an index of an allowed uplink access
slot on the basis of the value of the parameter
irrespective of a frame number of a frame used for
30   transmitting an uplink access slot.

Preferably, a selection means is provided in the mobile
station for randomly selecting from allowed access slots
determined by the determining means an uplink access slot

to be used for transmitting a preamble of said random access message. In this case, the consecutive preambles may be transmitted a predetermined number of access slots apart. The predetermined number may depend on a timing parameter received by said receiving means. Alternatively, the selection means may be arranged to perform the random selection any time a preamble needs to be transmitted.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, the present invention will be described in greater detail on the basis of a preferred embodiment with reference to the accompanying drawings, in which:

Fig. 1 shows a random access timing used in a random access channel according to a first example of the preferred embodiment of the present invention;

Fig. 2 shows a principle block diagram of a base transceiver station and a mobile station according to the preferred embodiment of the present invention;

Fig. 3 shows a table indicating a relationship between allowed access slots, a radio frame index and received parameters, according to a first example of the preferred embodiment of the present invention;

Fig. 4 shows a table indicating a relationship between allowed access slots and received parameters according to the first example of the preferred embodiment of the present invention;

Fig. 5 shows a table indicating a relationship between
allowed access slots and received parameters according to a
second example of the preferred embodiment of the present
invention; and

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Fig. 6 shows a table indicating a relationship between
allowed access slots, a radio frame index and received
parameters, according to the second example of the
preferred embodiment of the present invention.

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DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following, the preferred embodiment of the method
15 and system according to the present invention will be
described on the basis of a WCDMA system.

Before a mobile station (MS) can start transmitting on the
PRACH channel, it needs to acquire several parameters by
20 decoding a message broadcast from a base transceiver
station (BTS) via the Broadcast Channel (BCH). In
particular, the MS needs to know e.g. the available access
slots of the PRACH and AICH channels and the AICH
transmission timing parameter T_{AICH}. These parameters must
25 also be known at a layer 1 transceiver of the BTS, so that
a PRACH reception and a AICH transmission can be performed.

According to the preferred embodiment of the present
invention, the MS or a BTS can derive the available access
30 slots on the basis of a parameter A transmitted via the
BCH. Thus, the allowed access slots are defined on the
basis of the parameters A and T_{AICH}. However, the present
invention is not restricted thereto, i.e. the allowed

access slots may as well be defined solely on the basis of the parameter A alone.

After the allowed access slots have been determined at the
5 MS, the MS selects an access slot in which a preamble signature will be transmitted.

[First example]

10 Fig. 1 shows a first example of a possible timing configuration of the random access channels. In this case, a radio frame of the random access channels has a length of 10 ms, wherein both uplink and downlink access slots have a length of 1.25 ms, such that each radio frame comprises
15 eight access slots which can be allowed for the random access operation. For each uplink access slot, a corresponding downlink access slot is provided. Preambles and AIs are transmitted in time alignment with the uplink and downlink access slots, respectively. An uplink access
20 slot is transmitted a specified time period before the corresponding downlink access slot. This time period is equal to 1.75 ms or 3 ms for $T_{AICH} = 0$ and $T_{AICH} = 1$, respectively.

25 However, the present invention is not restricted to the above timing. Any other timing scheme, such as 15 access slots per 20 ms according to the second example described later, could be implemented as well.

30 The RACH message can be transmitted either three or four access slots after the latest transmitted preamble, depending on the value of T_{AICH}. The timing offset between uplink and downlink access slots, as seen from the MS, is equal to 0.5 ms. Therefore, an access slot starts 0.5 ms

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earlier in the uplink direction as compared to the downlink
direction.

According to Fig. 1, the access slots in each frame F are
5   denoted by indices 0 to 7, and the radio frames F are
numbered from 0 to (N_F-1), wherein N_F denotes the number of
available radio frames indices. In the above alternative
case of e.g. 15 access slots per 20ms (not shown), the
access slots are denoted by indices 0 to 14.

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In general, N_F must be an integer number large enough to
enable a selection combining in a switching means such as a
radio network controller (RNC). This can be achieved, if N_F
satisfies the following conditions:

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$$(N_F - 1) \ modulo \ 3 = 2, \ and$$
$$(N_F/2 - 1) \ modulo \ 4 = 3$$

Fig. 2 shows a principle block diagram of a BTS 10 and an
20   MS 20 according to the preferred embodiment of the present
invention.

The BTS 10 comprises a transceiver (TRX) 11 for receiving
and transmitting messages via corresponding radio channels
25   to the MS 20. Furthermore, the BTS 10 comprises a parameter
setting unit 14 in which random access parameters such as
the parameter A and the timing parameter T_{AICH} are set. The
setting may be controlled by the BTS 10 or on the basis of
an external command received from the mobile network.

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The parameter setting unit 14 is connected to a random
access (RAC) control unit 15 for performing a signal
processing required for the random access operations via

the BCH and AICH channels. Based on the parameters received from the parameter setting unit 14 the RAC control unit 15 supplies a corresponding broadcast message to the TRX 11 which transmits the broadcast message to MSs located in the

5 corresponding radio cell controlled by the BTS 10.

Furthermore, the RAC control unit 15 is connected to a switch 13 by means of which a connection to another network element such as a radio network controller (RNC) can be

10 established in order to receive e.g. a control command for externally controlling the parameter setting unit 14.

In case the BTS 10 receives a random access message from the MS 20 via the PRACH channel, the TRX 11 supplies the

15 received message to a slot determination unit 12 arranged to detect an index of the uplink access slot selected by the MS 20 from the allowed access slots defined by the parameters A and T_{AICH}. Based on the detected index of the received uplink access slot, the slot determination unit 12

20 determines indices of allowed downlink slots of the AICH channel, to be used for transmitting a response message to the MS 20. The determination of the indices of the allowed downlink access slots is performed on the basis of an algorithm described later.

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Additionally, the slot determination unit 12 is connected to the switch 13 in order to supply received random access messages to the network.

30 The MS 20 comprises a TRX 21 for transmitting and receiving messages via corresponding radio channels. The TRX 21 is connected to a parameter extraction unit 22, where the random access parameters such as the parameter A and the parameter T_{AICH} are extracted from the BCH channel. The

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extracted parameters are supplied to a slot determination
unit 23 arranged to determine the allowed uplink access
slots based on a predefined algorithm which may depend on
the value of the parameter T_{AICH} and which is described

5   later. The determined allowed access slots are supplied to
a slot selection unit 24 in which at least one desired
uplink access slot is selected. The uplink access slot may
be selected randomly based on the determined allowed access
slots. Once the selection is done, consecutive preambles

10   are transmitted either three or four access slots apart,
depending on the value of the parameter T_{AICH}.

Alternatively, the MS 20 may randomly select a number which
defines a subset of the determined allowed access slots,

15   which the MS 20 will then use for transmitting the random
access message.

The index of the selected access slot is supplied to a
random access (RAC) control unit 25 arranged for performing

20   a signal processing required for the random access
operations via the PRACH channel. The RAC control unit 25
generates a random access message based on an information
supplied from an I/O unit 27 via a signal processing unit
26 to the TRX 21, in order to be transmitted via the PRACH

25   channel to the BTS 10. The signal processing unit 26 is
provided for performing the required base band signaling of
any input or output signal exchanged between the RAC
control unit 25 and the I/O unit 27.

30   In the following, algorithms used by the slot determining
unit 23 and the RAC control unit 15 for determining allowed
uplink and, respectively, downlink access slots based on

the parameters A and T_{AICH} are described with reference to Figures 3 and 4.

As already mentioned, each radio frame F may contain eight

5   access slots each having a respective index a, wherein $0 \leq a \leq 7$. The index of the radio frame F ranges between 0 and (N_F-1). Alternatively, two consecutive radio frames $2 \cdot F$ and $2 \cdot F+1$ which form a 20 ms frame Γ may contain fifteen access slots, i.e. $0 \leq a \leq 14$.

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Initially, the network, e.g. the BTS 10, informs the mobile stations, located within the covered radio area, of the available access slots of the PRACH and AICH channel by transmitting the parameters T_{AICH} and A in the BCH channel,

15   wherein T_{AICH} may be equal to 0 or 1. In case $T_{AICH} = 0$, the value of A may range between 0 and 7 (i.e. $0 \leq A \leq 7$, or $000 \leq A \leq 111$ in binary expression). In case the value of T_{AICH} equals to 1, the values of the parameter A may range between 0 and 15 (i.e. $0 \leq A \leq 15$, or $0000 \leq A \leq 1111$

20   in binary expression).

According to the preferred embodiment, each bit of the binary expression of the parameter A indicates either an inclusion or an exclusion of a subset of access slots to

25   the set of allowed access slots.

Fig. 3 shows a table indicating allowed subsets of access slots in dependence on the parameter A and the frame index F, in case the value of the parameter T_{AICH} equals to 0.

30

In case A is equal to 0 (000 in binary expression), the transmission of a preamble signature or an AI is forbidden

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or disabled in all access slots, since each bit of the
binary expression is 0.

When A equals to 1 (001 in binary expression), the indices

5   of the allowed uplink access slots in any radio frame F are
obtained by the equation:

$$i = 3 \cdot N + (F \bmod 3)$$

where $0 \le N \le 2$,

10

wherein N is an integer number and i denotes the index of
the allowed access slot, wherein only access slots having
indices within the range 0 to 7 are valid. Based on the
above equation, the values indicated in the column A = 1 of

15   the table shown in Fig. 3 are obtained.

Since each bit of the parameter A indicates either an
inclusion or exclusion of a subset of access slots, the
subsets are defined by A = 1 (001), A = 2 (010) and A = 4

20   (100), which reflect the binary weights of the binary
expression.

Basically, the subsets for A = 2 are obtained by increasing
the indices of the subsets for A = 1 by one, wherein the

25   value 8 is deleted and transferred as a value 0 to the next
radio frame F+1. Similarly, the subset of allowed access
slots for A = 4 is obtained from the subset for A = 2 by
increasing the indices by one and transferring an obtained
value 8 as a value 0 to the subsequent radio frame. Thus,

30   an offset added to a basic subset (A = 1) is determined by
the value of the parameter A.

The other sets of allowed access slots for the remaining
values of the parameter A can be determined by adding

respective ones of the subsets given in the table of Fig. 3
based on the bit values in the binary expression of the
parameter A. E.g., in case the parameter A equals to 7
having the binary expression 111 and thus including all

5   binary weights, the subsets for A = 1, A = 2 and A = 4 are
all included in the set of allowed access slots, which
leads to the maximum allowable slot number. Furthermore, in
case A equals to 5 having the binary expression 101, the
subsets defined by A = 1 and A = 4 are added to obtain the

10   set of allowed access slots, and so on.

In the following, an index of an access slot is denoted by
a pair (F, a), wherein F $(0 \leq F \leq (N_F-1))$ denotes the frame
index and a $(0 \leq a \leq 7)$ denotes the access slot index

15   (within a frame F). E.g., the allowed access slots for A =
1 and F = 0, shown in Fig. 3, can be expressed as (0,0)
(0,3) and (0,6).

$(F^1_u, a^1_u)_0$ denotes any uplink access slot for A = 1 and

20   $T_{AICH} = 0$. The corresponding downlink access slots
determined by the slot determination unit 12 of the BTS 10
are given by $(F^1_d, a^1_d)_0$, wherein $F^1_d = (F^1_u + a^1_d/8)$
modulo N_F and $a^1_d = (a^1_u + 1)$ modulo 8 in the above case of
eight access slots per radio frame. In the equation for F^1_d

25   „/" stands for an integer division, i.e. truncation. Thus,
in general, a downlink access slot is given by $(F^x_d, a^x_d)_0$
$= (F^x_u a^x_u)_0 + 1$, for A = x and $T_{AICH} = 0$.

Accordingly, when A equals to 2 (010 in binary expression),

30   the allowed uplink access slots are defined by

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$(F^2{}_u, a^2{}_u)_0 = (F^1{}_u, a^1{}_u)_0 + 1$. Similarly, $(F^4{}_u, a^4{}_u)_0 = (F^2{}_u, a^2{}_u)_0 + 1$.

Due to the modulo 3 operation for the frame index F, the
5   allowed access slots are changed over three consecutive
radio frames. The reason therefore is that the cycle of the
PRACH access slot timing is 30 ms, which corresponds to
three radio frames.

10   Fig. 4 shows a table indicating the relationship between
the allowed access slots and the parameter A in case the
value of $T_{AICH} = 1$.

In this case, the allowed access slots are equal in any
15   radio frame, i.e. the determination is performed
irrespective of the frame index F. This is due to the fact
that the cycle of the PRACH access slot timing is one radio
frame if $T_{AICH} = 1$.

20   When $T_{AICH} = 1$, the parameter A ranges between 0 and 15,
i.e. comprises four bits in the binary expression.
Therefore, four different sets of allowed access slots are
defined, wherein each bit of the parameter A indicates
either an inclusion or exclusion of the corresponding set
25   of allowed access slots.

When A equals to 0 (0000 in binary expression), the
transmission of a preamble signature or an AI is forbidden
in all access slots.
30
When A equals to 1 (0001 in binary expression), the indices
of the allowed access slots are 0 and 4 for any value of F.
When A equals to 2 (0010 in binary expression), the indices

of the allowed access slots equal to 1 and 5 for any value
of F. When A equals to 4 (0100) and 8 (1000), the indices
of the allowed access slots are 2, 6 and 3, 7,
respectively, for any value of F.

The indices for the other values of the parameter A are
determined on the basis of the bit constellation in the
binary expression of A, as in the case of $T_{AICH} = 0$. Thus,
all available slots are allowed in the case of A = 15 (1111
in binary expression).

In general, the allowed downlink access slots are
determined by $(F^x_d, a^x_d)_1 = (F^x_u, a^x_u)_1 + 2$, for A = x and
$T_{AICH} = 1$. Thus, basically, the indices of the downlink
access slots are obtained by increasing the indices of the
uplink access slots by 2.

Thus, the number of allowed PRACH uplink access slots and
AICH downlink access slots can be configured in accordance
with the requirements of the random access communication or
the hardware resources at the BTS 10.

[Second example]

According to the second example of the preferred
embodiment, fifteen access slots are provided per 20 ms,
wherein two consecutive radio frames 2·F and 2·F+1 (0 ≤ F ≤
($N_F/2-1$)) contain fifteen PRACH or AICH access slots each
having an index a, where 0 ≤ a ≤ 15. In the present case,
the two consecutive radio frames 2·F and 2·F+1 are denoted
by Γ indicating a PRACH or an AICH frame of length 20 ms.
Thus, Γ contains 15 access slots having a length of roughly

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1.33 ms (20ms/15). The frame index Γ ranges from 0 to $(N_F/2-1)$.

Fig. 5 shows a table indicating the relationship between the allowed access slots and the parameter A in case the value of $T_{AICH} = 0$.

In case of $T_{AICH} = 0$, i.e. $0 \leq A \leq 7$, the transmission of a preamble signature or an AI is also forbidded in all access slots, if A equals to 0 (000 in binary expression).

When A equals to 1 (001 in binary expression), allowed access slots indices are 0, 3, 6, 9, and 12, i.e. $(\Gamma^1_u, 0)_0$, $(\Gamma^1_u, 3)_0$, $(\Gamma^1_u, 6)_0$, $(\Gamma^1_u, 9)_0$, and $(\Gamma^1_u, 12)_0$, for any Γ, since the cycle of the PRACH access slot timing is one radio frame.

When A equals to 2 (010 in binary expression), allowed access slots $(\Gamma^2_u, a^2_u)_0$ are obtained by $(\Gamma^1_u, a^1_u)_0 + 1$ for all available access slots $(\Gamma^1_u, a^1_u)_0$, i.e. allowed access slot indices are 1, 4, 7, 10, and 13. Now, (Γ^1, a^1) $= (\Gamma, a) + 1$ is defined by $\Gamma^1 = (\Gamma + a^1/15)$ modulo $N_F/2$ and $a^1 = (a + 1)$ modulo 15. Thus, allowed access slots are $(\Gamma^2_u, 1)_0$, $(\Gamma^2_u, 4)_0$, $(\Gamma^2_u, 7)_0$, $(\Gamma^2_u, 10)_0$, and $(\Gamma^2_u, 13)_0$, for any Γ.

Similarly, when A equals to 4 (100 in binary expression), allowed access slot indices are 2, 5, 8, 11, and 14, since $(\Gamma^4_u, a^4_u)_0 = (\Gamma^2_u, a^2_u)_0 + 1$.

In general, downlink access slots are obtained from

$$(\Gamma^x{}_d, a^x{}_d)_0 = (\Gamma^x{}_u, a^x{}_u)_0 + 1.$$

Fig. 6 shows a table indicating allowed subsets of access slots in dependence on the parameter A and the frame index Γ, in case the value of the parameter T_{AICH} equals to 1.

In the case of $T_{AICH} = 1$, i.e. $0 \leq A \leq 15$, the transmission of a preamble signature of an AI is again forbidden in all access slots, as long as A equals to 0 (0000 in binary expression).

When A equals to 1 (0001 in binary expression), allowed access slots indices for any frame Γ are obtained from the equation:

$$i = 4 \cdot N + (\Gamma \text{ modulo } 4)$$
$$\text{where } 0 \leq N \leq 3,$$

wherein N is an integer number and i denotes the index of the allowed access slot, wherein only access slots having indices within the range 0 to 14 are valid.

When A equals to 2, 4 or 8, allowed access slots are obtained from $(\Gamma^{2n}{}_u, a^{2n}{}_u)_1 = (\Gamma^n{}_u, a^n{}_u)_1 + 1$. Thus access slot indices for the case A = 2 can be computed from the indices obtained for the case A = 1, etc.

In general, downlink access slots are obtained from

$$(\Gamma^x{}_d, a^x{}_d)_1 = (\Gamma^x{}_u, a^x{}_u)_1 + 2.$$

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It is to be noted that, also in the second example, the
sets of allowed access slots are determined for the other
values of the parameter A by combining (adding) the subsets
shown in the tables of Figs. 5 and 6 in accordance with the

5   bit values of the respective binary expressions of the
remaining parameter values, as described in the first
example.

In the following, the selection of one or a plurality of

10 access slots by the slot selection unit 24 of the MS 20 is
described in greater detail.

The slot selection unit 24 may be arranged to randomly
select one of the allowed uplink access slots determined

15 based on e.g. one of the algorithms described in the first
or second examples by the slot determination unit 23. Once
the selection is done, consecutive preambles may be
transmitted either three or four access slots apart
(preamble-to-preamble timing), depending on the value of

20 T_{AICH}. Therefore, the MS 20 randomly picks a number x
defining the subset of access slots which will be used by
the MS 20. For $T_{AICH} = 0$ and $T_{AICH} = 1$, the values of x may
be taken from the sets {1, 2, 4} and {1, 2, 4, 8},
respectively. Then, the selected uplink access slots are

25 defined by all (F^x_u, a^x_u)'s or (Γ^x_u, a^x_u)'s, respectively.

Alternatively, the slot selection unit 24 of the MS 20 may
be arranged to randomly select any allowed uplink access
slot, when a preamble signature needs to be transmitted.

30 Once the access slot has been selected, the PRACH and AICH
timings are followed. Therefore, each time a preamble
signature needs to be transmitted, the slot selection unit
24 of the MS 20 randomly selects a number x from the sets

{1, 2, 4} or {1, 2, 4, 8} (depending on the value of T_{AICH}) and then transmits using the next allowed access slot of $(F^x{}_u, a^x{}_u)$ or $(\Gamma^x{}_u, a^x{}_u)$, respectively. In this case, the preamble-to-preamble timing may be three, four or five

5 access slots, depending on the value of x (case $T_{AICH} = 0$). For $T_{AICH} = 1$, the preamble-to-preamble timing may be four, five, six or seven slots, depending on the value of x.

It is to be pointed out that the random access method and
10 system described in the preferred embodiment can be applied to any radio network having a random access function between mobile terminals and fixed network elements. Furthermore, the discrete hardware units of the MS 20 and BTS 10 may be replaced by corresponding software features
15 of a control program controlling a CPU provided in the BTS 10 or the MS 20. The above description of the preferred embodiment and the accompanying drawings are only intended to illustrate the present invention. The preferred embodiment of the invention may vary within the scope of
20 the attached claims.

In summary, the present invention relates to a method and system for performing a random access operation between a mobile station and a network element such as a base
25 transceiver station, wherein allowed access slots for random access channels are defined by the network and signaled to the mobile station. The definition of the allowed access slots is performed on the basis of a parameter set by the base transceiver station and
30 transmitted to the mobile station which determines the allowed access slots based on the parameter. Thus, the number of allowed access slots can be defined by the

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network and can be changed dynamically based on the random access messaging load and the hardware requirements.